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Delivering extreme event preparedness education in schools: A systematic review of educational preparedness resources available in England

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ABSTRACT

Extreme events are infrequent, high impact incidents which can cause a range of physical, emotional, and psychological impacts for those affected. Children and young people in schools can be disproportionately affected by such events. Conversely, schools are often viewed as a platform for teaching and fostering preparedness. The present study aimed to elucidate what educational materials, intended to bolster preparedness for extreme events, are provided to schools in England. We also reviewed the literature related to the roll-out of new compulsory first-aid training for English schools. The study involved a systematic review of academic and grey literature, using academic databases and Google searches to find UK examples of educational preparedness materials. Educational materials which met criteria based on type of resource, target population or context, and preparedness outcomes were included. Twenty-six included items focused on preparing pupils for a range of extreme events, or the delivery of first aid in schools. All were resources to be used by teachers to deliver either stand-alone lessons or support existing lessons in the national curriculum for England. Many were published by national or international organisations or charities ($n = 23$), fewer were produced at a local level ($n = 3$). There was no evidence of any formal assessment or evaluation of effectiveness in bolstering preparedness knowledge across school populations. This is, to the authors' knowledge, the first review of preparedness education in schools within England. Outputs contribute novel findings and guidance for conducting further research in clarifying the needs of school populations and the improvement of preparedness for extreme events.

1. Introduction

Extreme events are often associated in the literature with extreme weather and climate change but can also include other types of incidents such as malicious attacks and infectious disease [1,2]. For the purposes of this study, we have adopted a broad definition that understands extreme events as unusual incidents that have large-scale impacts, such as extensive flooding, earthquakes, extreme weather, power-outages, terrorism, and public health emergencies, like the COVID-19 pandemic. In recent years extreme events have become more frequent and catastrophic for communities around the world [1,3]. Overcoming their impact is therefore of paramount importance to governments and organisations worldwide [4].

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School-aged children and young people are impacted by a wide range of extreme events. Events range from hurricanes in Puerto Rico [5], to wildfires in Canada [6,7], tsunami in Southeast Asia [8,9], and terrorism in Indian Kashmir and Israel [10,11]. The potential for harm of children and young people is well documented, with evidence indicating that this population subgroup experiences deleterious social, behavioural, and psychological outcomes [12,14]. Specifically, children can lose access to their typical social infrastructure of family, friends, and school in the aftermath of an extreme event. These losses can have negative consequences on their livelihood, emotional support, and mental health [12–14]. A minority of children and young people affected by extreme events will go on to develop serious psychosocial issues or psychiatric disorders, such as post-traumatic stress disorder and depression [15].

1.1. Preparedness education

Pre-event preparedness education – or ‘preparedness education’ – is one pathway to establishing a broad notion of readiness to diminish these impacts [1,16,17]. Pre-event preparedness “pursues the objectives of prevention” through provision of measures, activities or learning that can mitigate the possible negative impact of hazards or extreme events before they occur [18,19]. Schools are identified as an appropriate platform to provide preparedness education since they exist as a hub in the community wherein classroom teachers provide a sense of security, developmentally appropriate pastoral care, as well as being cognisant of students’ typical emotional and behavioural patterns to cultivate learning [20–26].

Providing preparedness education consistently to children and young people in schools may be particularly beneficial since it reaches these groups in their “formative learning and development years” [14,27]. For example, embedded, ongoing, formal preparedness education can help children become ‘active participants’ in preparedness knowledge, resulting in empowered decision-making in the event of experiencing an extreme event [28–30]. This in turn is thought to have a “multiplier effect” when knowledge is transferred from schools and into households and the community [14,27,31–33]. As such, despite the potential for children and young people to be disproportionately affected by extreme events, they have the potential to be a ‘major asset’ in bolstering preparedness for extreme events at both a personal and community-wide level [27].

While it has been established that it is important to prepare young people for extreme events, there are different ways in which preparedness education can be delivered. Some of this variation may be addressed by breaking preparedness education into two distinct components: ‘preparedness learning’ and ‘preparedness education’. Firstly, preparedness ‘learning’ refers to a non-institutionalised, voluntary, and informal learning. Informal learning may therefore “occur in the family, workplace [and] local community” and exist as a part of daily life. For example, seeing flood warning signs in the community, and knowing to ‘stop, drop and roll’ during a fire, are examples of modes of informal learning. [34] asserts that informal learning likely “accounts for the largest number of examples of disaster education” delivered to populations. On the other hand, ‘preparedness education’ relies on a provider or institution who is responsible for the delivery of preparedness education, such as a school, and can occur either formally or non-formally [34,35]:

1. ‘Formal learning’ preparedness education refers to education that is “institutionalised, intentional and planned” and part of a “formal education system of a country ... recognised as such by the relevant national education authorities”, such as in a national curriculum [34,36]. For example, a curriculum-based resource from New Zealand – entitled *What’s the Plan, Stan?* – strives to teach disaster science and preparedness to students in primary schools with direct links to “any area of ... Science, English, Social Studies, and Health and Physical Education” [34,37].

2. ‘Non-formal learning’ preparedness education is an “alternative and/or complement to formal education” and typically occurs in the form of short or low intensity courses, workshops, seminars, or drills [14,34,36]. For example, after many children were affected and displaced by earthquakes in Indonesia, mock evacuation drills were introduced into the country’s national curriculum and conducted in schools to prepare students for possible future earthquakes [4].

1.2. Preparedness education in English schools

In the UK, children and young people have been impacted by a variety of extreme events in recent years. Examples include the 2017 Manchester Arena attack [38,39], the COVID-19 pandemic [40], and flood-damage caused by storm Babet in 2023 [41,42]. The potential impacts of these events are varied. Research indicates that, for children and young people who have experienced terrorist violence, consequences can include chronic pain and fatigue, with further impact on cognition, behaviour, and school performance [43–45]. Interrupted learning caused by the COVID-19 pandemic has had ongoing effects on sleep patterns, cognitive function, potential social isolation, and stress for students who were working remotely [46]; United Nations Educational, Scientific and Cultural Organisation [47]. Finally, those who experience flooding in their community or school, may experience disruption to their education, lack of access to school buildings, changes to teaching schedules, and loss of regular school socialisation [48–50].

The UK policy-making and regulatory landscape is shifting in respect to preparing children for future extreme events. Recent trends build upon the long-standing designation of children as a social group particularly vulnerable to extreme events, including the possible broad ranging impacts of extreme events on children and young people (e.g., to cognition, behaviour, school interactions, and sleep) [51]. This designation is especially useful when combined with the UK Government’s identification of “the most serious risks facing the UK”, through the National Risk Register (NRR) [52]. The NRR sets out a “reasonable worst-case scenario” for 89 different risks, under 9 risk themes. Of these, four were represented in the English preparedness resources included in this systematic review. These were: *Terrorism* (e.g., terrorist attacks in venues and public spaces, malicious rail incident), *Accidents and Systems Failures* (such as regional failure of electricity network, major fire), *Natural and Environmental Hazards* (such as storms, extremes of heat, and flooding), and *Human, Animal, and Plant Health* (such as pandemic). Finally, the UK Government’s designation of children as a vulnerable population, alongside the identification of national risks that may affect them, can now be combined with a government require-

ment for all schools in England¹ to plan for various emergencies with an ‘all-hazards’ approach to preparedness [53]. Considered together, these elements constitute a three-pronged rationale for exploring the effectiveness of delivering extreme event preparedness in schools in England.

Translation of these planning tools and policy decisions into English schools takes many forms. ‘All-hazards’ emergency plans must be “be generic enough to cover a range of potential incidents” including, for example, public health incidents, severe weather (such as extreme heat, flooding, storms or snow), major fires, power outages, and disasters in the schools’ local community, as outlined by the Department for Education [53]. As part of this, schools in England have been advised to consider school security and conduct lockdown drills for the eventuality of a hostile intruder, terrorist attack or other criminal activity [54]. Further opportunities to deliver preparedness education to students in schools in England occur within the national curriculum. For example, within the compulsory elements of the Geography curriculum (i.e., for Key Stages 1–3, or students aged 5–14) teachers are expected to discuss possible extreme events, including, volcanoes and earthquakes, and global weather [55]. In addition to this, from September 2020, children in English schools have been expected to learn ‘lifesaving first-aid skills’ as a mandatory part of health education [56–58].

1.3. Mapping and reviewing extreme event preparedness education in English schools

Whilst the literature suggests that there are advantages of using schools as a conduit to deliver preparedness education, many examples come from international sources, and little is known about the delivery of preparedness education across schools in England [14]. This review is designed to identify publicly available resources to map the current practices of teaching ‘extreme event preparedness education’ in schools across England. It focuses on preparedness education as occurring formally (i.e., in the curriculum) or non-formally (i.e., practiced as a drill), delivered in a school environment or an environment/programme commissioned by the school. Preparedness education may refer to or explore any aspect of preparedness which has the aim of bolstering an individual level of preparedness for an extreme event, such as risk perceptions, extreme event knowledge, behavioural intentions and behaviour change in relation to extreme events, and aspects of resilience, response, and recovery. Additionally, due to the recent requirement for schools to deliver first-aid education, any resource intended to support the delivery of first aid by teachers in schools will be included. Specifically, the objectives of this review are to:

- i. Identify the publishers or authors of educational resources for extreme event preparedness education in schools in England.
- ii. Identify the [event] focus of educational resources employed in providing extreme event preparedness education in schools in England.
- iii. Identify the aims or intended outcomes of extreme event preparedness educational materials in schools in England.
- iv. Identify the methods employed in providing extreme event preparedness education in schools in England (i.e., format of resources, intended use of resources, intended delivery of resources).

This is, to the authors’ knowledge, the first review of extreme event preparedness education intended for schools in England, conducted within the context of England and the English curriculum. Doing so will enable authors and researchers in the field of preparedness to understand current practice in the delivery of preparedness education, to school-aged children and young people in England.

2. Methods

2.1. Search strategy

A search of academic literature was conducted using Ovid MEDLINE, APA PsycINFO, Global Health, and Scopus. References and forward citations of included articles were searched. Databases were searched from inception to May 30, 2023. Terms related to: (i) students, schools and education were used in combination with (ii) incident type, and (iii) geographic location (UK, England). Forward citations were searched, and any stand-alone documents or guidance that may have been referenced in the literature were searched for via Google.

A second search of the grey literature was completed via Google to identify any further stand-alone guidance documents. 128 separate searches were completed, using a variation of search terms: ‘Preparedness’ and ‘resilience’ were used in combination with an incident type and geographic location, for example ‘Disaster preparedness materials for schools in England’, ‘Emergency preparedness materials for schools in England’ and ‘Mass casualty resilience materials for schools in England’. The following Google Advanced filters were applied: a) Language: English, b) Region: England, United Kingdom. The first 20 pages of results were searched.

Searches were conducted between May and July 2023. See [Appendix 1](#) for the full search strategy.

2.2. Inclusion criteria

Inclusion criteria were based on the (a) type of educational material for preparedness, (b) target population or context, and (c) outcomes. See [Table 1](#) for full details of the inclusion criteria.

2.3. Data extraction

Data extraction was completed using qualitative content analysis. This method uses predetermined codes to extract data and construct meaning [59]. The study objectives were used to guide data extraction. These were to identify (i) the publishers or authors, (ii)

¹ The school curriculum is a devolved policy area across all four nations of the United Kingdom. The present study focuses on the English national curriculum.

Table 1
Inclusion criteria.

	Inclusion criteria
Type of educational material	<ul style="list-style-type: none"> • Written in English • Relevant to schools in England • Published in peer-reviewed journals and report on primary data • Published through or in affiliation with government, universities, local councils, schools, and any other professional bodies
Population or context	<ul style="list-style-type: none"> • Presented guidance intended for children in schools in England • Reported data from children in schools in England • Conducted with students aged between five- and eighteen-years-old
Outcomes	<ul style="list-style-type: none"> • Any outcomes concerning bolstering preparedness for extreme events, (including individual risk and risk perceptions, disaster knowledge, behavioural intentions, behaviour change, resilience, response, and recovery) • Studies which presented data in retrospect of an extreme event • Studies which inform a future response to an extreme event

the [event] focus, (iii) the aims or intended outcomes, and (iv) the methods employed in delivering educational resources for extreme event preparedness education in schools in England.

2.4. Ethical considerations

Ethical approval was not required for the literature review since all data collected was publicly available.

3. Results

Following screening (see Fig. 1), twenty-six examples of an educational resource, designed to support the delivery of extreme event preparedness education in schools, were included in the review. All items were available as of July 2023. Table 2 provides an overview of resources, including the author, date, organisation type and location (i.e., UK- or internationally based), resource focus and location of focus (i.e., UK or international examples of extreme events), and information on target age group of resource. The focus of resources was categorised using the risk theme scenarios drawn from the NRR for England. Results were written up using the headings ‘Type of Organisation’, ‘Focus of educational resources’, and ‘Aims, intended outcomes and methods of delivering educational resources’, as per the research objectives of the study.

3.1. Type of organisation

Data related to organisation type (see Table 3) and location of organisation (see Table 4) were extracted to elucidate the publishers or authors of preparedness education resources. Resources were most frequently published by charities; nineteen resources were published by five different charities. These were the British Council [61], British Red Cross [62–71,85], Christian Aid [72–74,86], and St John Ambulance [58,81–83]. Four resources were published by government associated organisations. These were organisations either funded or partially funded by government departments; they included Counter Terrorism Policing [87], the Met Office [77,78], and the UN Office for Disaster Risk Reduction [84]. Only three local authorities published resources. These were Blackburn with Darwen Borough Council [60], Humber Local Resilience Forum [76], and North Northamptonshire Council and West Northamptonshire Council [79]. Of the twenty-six included resources, only one was published by an international organisation, the UN Office for Disaster Risk Reduction [84].

3.2. Focus of educational resources

Included resources were also classified according to their focus. Any resource related to the delivery of first aid was categorised as ‘First Aid’ (N = 5). All other resources were classified using categories included in the UK National Risk Register [52]. Specifically, these were classified as ‘Natural and Environmental Hazards’ (N = 18), which included resources which referred to flooding, storms, extremes of temperature, droughts, volcanic eruptions, earthquakes, and wildfires; ‘Accidents and System Failures’ (N = 2), which included resources relating to major fires and power outages; ‘Human, Animal and Plant Health’ (N = 1), which included resources that referred to pandemics; and ‘Terrorism’ (N = 1), which included resources that referred to possible gun- or knife-related terrorist incidents.

Two resources referred to multiple risks, as identified in the NRR, taking an ‘all-hazards’ approach to education for a combination of possible extreme events. Blackburn with Darwen Borough Council [60] provided guidance on flooding (Natural and Environmental Hazards), power-outages (Accidents and System Failures), and pandemics (Human, Animal and Plant Health), and the Humber Local Resilience Forum [76] provided guidance on flooding (Natural and Environmental Hazards) and fire and power outages (Accidents and System Failures). Table 5 shows the frequency for each type of educational material according to its focus.

Resources were also categorised according to whether they presented UK or International examples (see Table 6). A little over half (N = 17) of the resources focused on either UK first-aid practice or UK examples of extreme events. UK examples referred to Natural and Environmental Hazards (including extreme weather, storms, heatwaves, and flooding), Terrorism (such as a gun or knife terror attacks), and Human, Animal and Plant Health (such as pandemics). All international examples referred to environmental hazards including case studies of wildfires in the Amazon rainforest, hurricane Dorian in the Bahamas, tropical storms in Guatemala, volcanic eruptions in Hawaii, an earthquake in Chile, Haiti, Italy, and Nepal, an earthquake and tsunami in Indonesia, flooding in Pakistan and the Philippines, and typhoon in Taiwan.

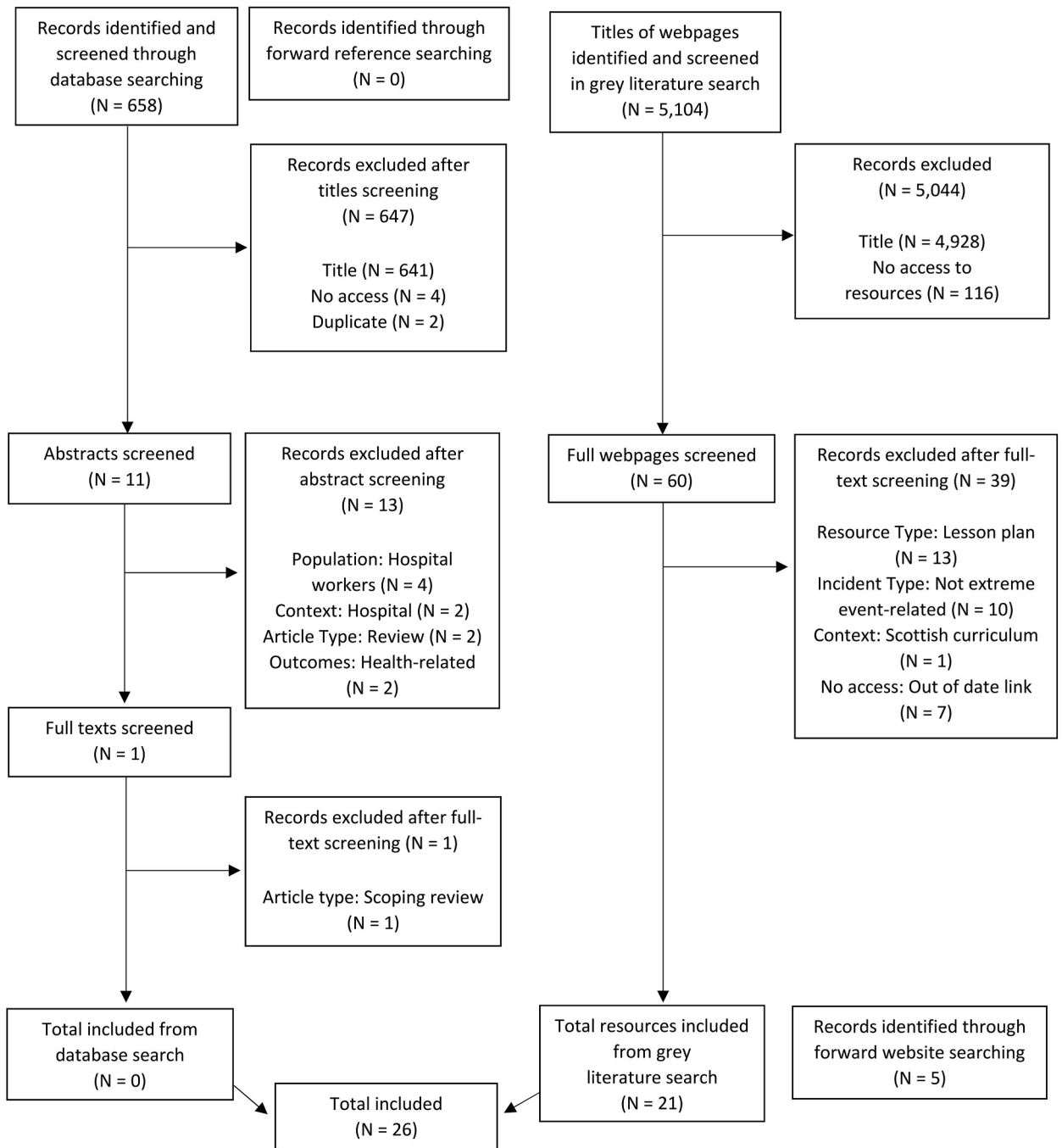


Fig. 1. Flowchart to show the selection of resources included in the review of educational materials aimed at bolstering preparedness across schools in England with reasons for exclusion.

3.3. Aims, intended outcomes and methods of delivering educational resources

Resources identified by this review often referred to aims as ‘learning objectives’ or ‘learning outcomes’. Some organisations published clear aims under specific headings, including what children and young people should have learned by the end of the lesson. Other resources included aims that were more broad or implicit. For example, increased student awareness of different examples of extreme events as an outcome of using the educational resource.

All resources were designed to support a lesson, or series of lessons, related to preparedness for extreme events. Some organisations provided lesson plans as part of their resource packages. Lesson plans were excluded from the review since they were designed to support teachers, rather than students. Only resources aimed at students were included. The majority of resources were designed to

Table 2
Overview of included educational resources.

Author	Organisation (Location)	Resource focus (Location)	Target school age group
Blackburn with Darwen Borough Council [60]	Local Authority (UK)	Multiple - Natural and Environmental Hazards; Accidents and System Failures; Human, Animal and Plant Health (UK)	Primary [Key Stage 2; Year 5; ages 9–10 years]
British Council [61]	Charity (UK)	Natural and Environmental Hazards (UK)	Secondary [Key Stage 3; Years 7–9; ages 11–14]
British Red Cross [62]	Charity (UK)	Natural and Environmental Hazards (UK)	Primary [Key Stage 1 and Key Stage 2; Years 1–6; ages 5–11]
British Red Cross [63]	Charity (UK)	Natural and Environmental Hazards (International)	Secondary Ages 11–19
British Red Cross [64]	Charity (UK)	Natural and Environmental Hazards (International)	Secondary Ages 11–16
British Red cross [65]	Charity (UK)	Natural and Environmental Hazards (UK)	Secondary Ages 11–16
British Red Cross [66]	Charity (UK)	Natural and Environmental Hazards (International)	Secondary Ages 11–19
British Red Cross [67]	Charity (UK)	Natural and Environmental Hazards (International)	Secondary Ages 11–16
British Red Cross [68]	Charity (UK)	Natural and Environmental Hazards (International)	Secondary Ages 11–16
British Red Cross [69]	Charity (UK)	First Aid (UK)	Primary (KS1-KS2)
British Red Cross [70]	Charity (UK)	First Aid (UK)	Secondary (KS3-KS5)
British Red Cross [71]	Charity (UK)	Natural and Environmental Hazards (UK)	Primary
Christian Aid [72]	Charity (UK)	Natural and Environmental Hazards (UK & International)	Primary (ages 7–11)
Christian Aid [73]	Charity (UK)	Natural and Environmental Hazards (International)	Primary (ages 7–11)
Christian Aid [74]	Charity (UK)	Natural and Environmental Hazards (International)	Ages 9+
Counter Terrorism Policing [75]	Government Associated Organisation (UK) ²	Terrorism (UK)	KS3 & KS4 (ages 11–16)
Humber Local Resilience Forum [76]	Local Authority (UK)	Multiple: Natural and Environmental Hazards, Accidents and System Failures (UK)	KS2
Met Office [77]	Government Associated Organisation (UK)	Natural and Environmental Hazards (UK)	KS2 (ages 7–11)
Met Office [78]	Government Associated Organisation (UK)	Natural and Environmental Hazards (UK)	KS3 (ages 11–14)
North Northamptonshire Council and West Northamptonshire Council [79]	Local Authority (UK)	Natural and Environmental Hazards (UK)	KS2 (Year 5, ages 9–10)
Royal Geographical Society [80]	Charity (UK)	Natural and Environmental Hazards (International)	GCSE (15–16)
Royal Geographical Society [77]	Charity (UK)	Natural and Environmental Hazards (UK)	KS3 (ages 11–14)
St John Ambulance [81]	Charity (UK)	First Aid (UK)	KS2 (ages 7–11)
St John Ambulance [82]	Charity (UK)	First Aid (UK)	KS3 (ages 11–14)
St John Ambulance [83]	Charity (UK)	First Aid (UK)	KS4 (ages 14–16)
UN Office for Disaster Risk Reduction [84]	Government Associated Organisation (International)	Natural and Environmental Hazards (International)	Not specified

Table 3
Frequency for each identified organisation type.

Type of organisation	Frequency [N (%)]
Charity (UK)	19 (73.1 %)
Local authority (UK)	3 (11.5 %)
National government associated organisation (UK)	3 (11.5 %)
International government associated organisation	1 (3.8 %)
Total	26

Table 4
Frequency of organisation by location.

Location of organisation	Frequency [N (%)]
UK-based	25 (96.2 %)
Internationally based	1 (3.8 %)
Total	26

² These were organisations either funded or partially funded by government departments (for example, the Met Office is an executive agency, sponsored by the Department for Science, Innovation and Technology).

Table 5

Frequency for each educational resource as per their focus.

Focus of resource	Frequency [N (%)]
Natural and Environmental Hazards	20 (68.9 %)
First Aid	5 (17.2 %)
Accidents and System Failures	2 (6.9 %)
Human, Animal and Plant Health	1 (3.4 %)
Terrorism	1 (3.4 %)
Total	29*

*N = 29 as two resources referred to > 1 category of hazard.

Table 6

Frequency for each educational material as per the location of focus.

Location of focus	Frequency [N (%)]
UK	15 (53.5 %)
International	13 (46.4 %)
Total	28*

*N = 28 as two resources referred to both UK and International examples of an extreme event.

fit into lesson times to support lessons that were already a part of the national curriculum. The lessons included a variety of multi-media methods including worksheets, PowerPoint presentations, interactive games and quizzes, worksheets and activity books, role-play tasks, case studies, activity days, and demonstrations.

In addition to this, most items (96.2 %, N = 25) were designed with a specific age group in mind. Table 7 shows the frequency of target school age-group for resources. It was not possible to ascertain the target age group of the UN interactive game [84]. Those targeted at primary schools were for students aged between 3- and 11-years-old; those targeted for secondary school were for students aged between 11- and 16-years-old.

The aims, intended outcomes, and methods of the resources for each organisation type are summarised in the following sections. The approaches adopted by (i) Charitable groups, (ii) International government associated organisation, (iii) National government associated organisations, and (iv) Local authorities are explored for each resource included in the review.

3.3.1. Charitable organisations

Nineteen resources were published by UK-based charitable organisations. St John Ambulance published a suite of first aid-related resources (N = 3) with specific aims informed by government guidance on delivering first-aid education in schools. British Red Cross published ten items included in the review, related to both first aid and 'natural and environmental hazards'.

The St John Ambulance [81–83] resources were designed to provide an age-appropriate knowledge of first aid to support the integration of first-aid education into an ongoing programme of learning. Across Key Stage 2 (ages 7–11) students were expected to learn "how to make a clear and efficient call to the emergency services", as well as basic first-aid concepts. At Key Stage 3 (ages 11–14), resources were designed to establish "how and when to deliver CPR and the concept and use of Automated External Defibrillation (AED)". Finally, resources provided for Key Stage 4 (ages 14–16) were designed to consolidate the learning from across KS2 and KS3 alongside development of the concepts of common first-aid emergencies, such as delivering basic life support, recovery from choking, and how to deal with bone, muscle, and joint injuries.

As part of their "First Aid Champions" campaign (N = 2), British Red Cross provided primary (ages 4–11) and secondary (ages 11–16) school children unique, age-appropriate first-aid related educational resources [69,70]. Campaign materials for primary ages (4- to 11-years-old) included interactive tasks and videos where learners were introduced to six demographically similar characters to learn first-aid skills from. For secondary-aged "First Aid Champions" (11- to 16-years-old), materials provided information on first-aid skills (i.e., identifying how and when to deliver cardiopulmonary resuscitation (CPR) and the use of Automated External Defibrillation (AED)) supported by films, activities, and quizzes. Materials were designed to provide first-aid education in simple steps, including a key action to remember in each scenario. In addition to this, and in line with the charitable goals of [71]; learners are also taught about "kindness, how to cope and keep calm, and how to keep yourself safe" [69,70]. Learners are encouraged to take this education and share it with others.

Table 7

Frequency of target school age of resources.

Target age group	Frequency [N (%)]
Secondary age (11–16 years old)	15 (57.7 %)
Primary age (3–11 years old)	10 (38.5 %)
Not specified	1 (3.8 %)
Total	26

All first-aid resources included in this study were tailored specifically for either primary or secondary school pupils, including first-aid tasks based on their developmental age. All first-aid resources provided suggestions as to where resources could fit in the school schedule, principally in PSHE or tutor-time sessions.

As well as first-aid education, the British Red Cross also published resources related to natural and environmental hazards (N = 8), including flooding, wildfires, hurricanes, earthquakes, tsunamis, volcanoes, and heatwaves. Seven of these resources were designed for use in PSHE or geography, and one provided guidance as to how to use the resources as part of an 'activity' lesson (i.e., when 'normal' lesson-time was substituted for the activity). All British Red Cross resources related to natural and environmental hazards included clearly specified aims with specific learning objectives that students would meet after using each resource [62–68,70]. For example, a resource related to earthquakes outlined that "learners will: (1) gain understanding of different types of natural hazards and disasters, (2) explore the short- and long-term consequences of a natural disaster, (3) discuss the humanitarian response and what might make communities resilient". Overall, these resources were designed to raise awareness of extreme events, possible outcomes from extreme events, relief efforts and humanitarian work conducted by the British Red Cross, to enable students to be 'better prepared for an emergency in the home or at school' [85].

Another educational package, published by British Red Cross, known as the '*Pillowcase Project*' included resources that focus on weather emergencies and raise awareness of how they can affect people, with the additional goal developing and practising coping skills [71]. The resources offer the option to create and decorate an emergency 'grab bag' in lesson time [71]. The Pillowcase Project explained that a grab-bag would be used to hold important or necessary items in an evacuation scenario (British Red Cross n.d.-b). The Pillowcase Project was targeted at Key Stage 2 learners, aged 7–11 and was intended to be used as lesson content, for example as a stand-alone teaching about weather emergencies. This educational package, like the other resources published by British Red Cross, provided specific aims and outcomes indicating that learners should be able to recognise and respond to a range of weather emergencies they might face in the UK and their local area. The Pillowcase Project also encouraged students to share the disaster-preparedness knowledge that they learned with parents and family members as a means to bolster preparedness more widely in the community [71].

Other resources, such as those provided by Christian Aid (N = 3), highlight the impact and consequences of international natural disasters, using the example from Bangladesh, the Philippines and Haiti [72–74]. Two of the Christian Aid resources were designed for classroom use, with the final resource entailing a full school day role-play, vignette-based activity (i.e., delivered during both lessons and school break times). The materials explained how to identify different types of incidents, the practical and emotional impacts of disasters, possible associations between disasters and climate change, and the international relief work that Christian Aid undertakes to support those affected or living in poverty. These aims align with Christian Aid's international charitable and relief work [88]. The resources were developed for primary-aged school groups aged 7- to 11-years old and those ages 9-years 'and older' [72–74].

Two resource packages included in the review were published by the Royal Geographical Society [80][86]. These were intended for use in secondary school geography lessons, employing methods such as factsheets, work sheets, case studies and (card-sorting) games. The first resource package, which focused on flooding in the UK, was designed for Key Stage 3 learners (aged 11- to 14-years old), with the aim of providing an awareness of 'preparedness' as well as knowledge of what actions should be taken in the event of flooding. This resource package also highlighted how changing physical and human processes are contributing factors to flooding [86]. A second resource package was designed to educate learners about typhoons in Taiwan. This was intended to support a GCSE geography module covering landscape systems, hazards and risk, the carbon and water cycles, and climate change, over three lessons. Its aims were to "examine the likely impacts of typhoons on rural communities in mountainous southern Taiwan and ... assess the effectiveness of associated disaster preparedness and crisis response measures" [80].

The 'Storm coming!' resource published by the British Council [61] includes games and activities to be completed in the classroom to support learning related to extreme weather; these were developed specifically for lower secondary learners (KS3, Years 7–9, ages 11-14-years-old). The activities highlight different weather events in the UK, asks students to think about how weather affects their local area, as well as a 'news report' vignette-based scenario based on an ongoing weather event. The aims of the activities were to raise awareness of increasing risk of extreme weather events due to global heating, review vocabulary of weather events (e.g., using examples of hurricane, blizzards, heatwaves), popular weather-related 'collocations' such as 'heavy rains', and 'stay indoors', which students can learn and remember.

3.3.2. International government associated organisation

The review included a single resource published by an internationally based government associated organisation. This resource was written and published in English and did not need to be translated. The UN Office for Disaster Risk Reduction [84] provided resources in the form of an interactive game for children to play to support learning about extreme events. This game offered learning objectives related to different risks and disasters, including tsunami, wildfire, and earthquakes, as well as what to do in the event of different disaster scenarios, and identifying potential defence mechanisms. The webpage associated with the game also included informational resource packs for teachers to support delivery [84]. It was not possible to elucidate the specific age-group this resource was designed for, nor whether it should be delivered in lesson time.

3.3.3. National government associated organisations

Three resources published by two different national government associated organisations addressed natural and environmental hazards, and terrorism. The Met Office [77,78] (N = 2) provided separate resource packages for educating learners in primary and secondary schools about 'extreme weather'. Extreme weather examples included hurricanes, tornadoes, dust storms, drought, and

flooding. The Met Office provided worksheets and activities for lessons, using learning vignettes, interactive sessions, and ‘DIY activities’ to integrate knowledge about climate change, its impact on the planet and the possible contribution of climate change to extreme weather. Resources designed for students aged 7- to 11-years-old had an international focus [77] whereas those designed for students aged 11- to 14-years-old provided both international and UK-based extreme event examples [78].

The resources published by Counter Terrorism Policing [87] had a specific aim of teaching the correct behavioural protocol for terrorist incidents involving a gun or knife: to ‘Run, Hide, Tell’. They sought to familiarise student with the ‘Run, Hide, Tell’ message through a series of core videos with accompanying PowerPoint presentations, worksheets, and leaflets showing what to do in a gun or knife weapons attack. The videos had been adapted for 11–14 and 15-16-year-olds and included additional resources with subtitles and support for students who use British Sign Language. The ‘Run, Hide, Tell’ sessions were developed in collaboration with the PSHE Association intended to be delivered in PSHE lessons in school. Counter Terrorism Policing [87] identify that these resources are novel in addressing terrorism safety in the classroom.

3.3.4. Local government associated organisation

Humber Local Resilience Forum [89], an English local authority, provided a package of lesson content designed to educate students about floods, including flood risks and the potential impact of flooding in the local community. This resource provides curriculum-links for lessons for students in Year 5 (aged 9- to 10-years old) and includes activity sheets (e.g., word glossaries), and PowerPoint presentations designed to promote engagement and active learning.

Blackburn with Darwen Borough Council [60] provided a suite of “pull off the shelf resources” entitled the *Schools Community Resilience Project*, which aimed to “help children to be prepared and not scared” for a possible extreme event. Their resources were also designed to promote wider community resilience and raise awareness of the potential impacts on families in the event of an emergency [60]. Resources were designed to be delivered in school, with students in Year 5 (age 9–10), either over a series of weeks, one session per week, or over consecutive days and included activities related to defining an emergency, researching the roles of the emergency services, and learning Met Office weather symbols. These elements were intended to be recapped and revised throughout the delivery of education to consolidate preparedness knowledge [60].

Finally, the Humber Local Resilience Forum [76] published an activity booklet for students to use and complete in an appropriate lesson time. Activities were centred around identifying different types of emergencies – from individual-level emergencies, such as small-scale fires in the home, to large-scale emergencies, such as flood events – how and when to call 999, and which appropriate emergency service can help in different scenarios. Only one of the scenarios – flooding in the community – was concerned with an extreme event which would be classified as part of the NRR. The activity booklet directed learners to the UK Government and Environment Agency flood-support pages. Activities and learning were presented in the form of snakes and ladders games, spot the difference activities and dot-to-dot drawings. It was not possible to ascertain which lesson time the resources were intended to be used in, nor which age-group the resources targeted.

4. Discussion

4.1. Extreme event preparedness education in England

Our systematic search of academic and grey literature for extreme event preparedness education materials for schools in England identified twenty-six documents. Extreme events identified in the review were categorised using the UK National Risk Register (NRR) categories for extreme events. This included Natural and Environment Hazards, Accidents and System Failures, Human, Animal, and Plant Health, and Terrorism. Other resources were designed to support the novel delivery of first-aid education in schools in England. All these preparedness education resources were designed to be embedded into school lessons in England. Other resources were designed to support the novel delivery of first-aid education in schools in England. Their formats varied and included worksheets, videos, PowerPoint presentations, activities, games, and quizzes. Some organisations published suites of resources to support multiple lessons or activity days in schools, others published stand-alone guidance to support one-off sessions. Some of these resources provided detailed aims and guidance as to which lessons their resources would be best suited to. Overall, all of our resources (N = 26) were designed to increase knowledge of extreme events and provide demographically suitable education.

It became evident that educational extreme event preparedness materials for English schools are designed to increase extreme event knowledge, bolster the notion of preparedness and, in some cases, encourage learning to be shared into the community. However, we could not find evidence of whether these goals had been assessed or if the preparedness education materials had any noticeable impact on improving preparedness outcomes. As such, the ‘active participation’ of children may be acknowledged in resources delivered and utilised in England but it is not known whether this method is effective in practice. This is a concern, as teachers may expend valuable school resources (i.e., time and money) delivering this work without evidence to indicate that these efforts improve knowledge, awareness and, importantly, the level of preparedness across school populations. Evaluation of existing materials could bring many benefits in a timely manner. For example, evaluations would enhance understanding of the possible impacts that preparedness education has across communities. Stakeholders would gain greater understanding of the impact of their efforts to bolster community preparedness or to produce unintended consequences such as anxiety, stigma, or fear. However, it is possible that these evaluations may not have been published publicly which means that they would not have been identified and included in the review.

Additionally, none of the resources identified by this review provided evidence of co-authorship with schools nor teachers, and only one addressed local vulnerability to risks (Natural and Environmental Hazards). When local organisations and authorities were involved, their geographic focus varied greatly (e.g., local, regional, national, international). Our review shows that, within England, UK charities are the main publishers of educational preparedness resources, followed by national government associated organisa-

tions, local authorities, and finally international government associated organisations. In fact, almost all the resources identified in the review were produced by national or international organisations and charities (N = 23), rather than by local organisations or authorities (N = 3). Of the three resources published by local authorities, only one addressed local needs or vulnerabilities to flooding (West Northamptonshire Council & North Northamptonshire Council), while the others addressed extreme events at a more general level, as opposed to vulnerabilities in the region (Humber Local Resilience Forum and Blackburn with Darwen Borough Council). Both of these trends are concerning as lack of collaboration between developers and deliverers of educational preparedness resources may hinder the translation of preparedness activities and education into a local context. Evidence suggests that local councils or charities may be particularly valuable when writing preparedness materials due to their awareness of the wider needs of the local community [90,91]. Similarly, teachers have a potentially helpful role in addressing local vulnerabilities and needs, due to their centrality to the community [23].

Our review also uncovered a dearth of publicly available resources published by centralised UK Government departments responsible for education (i.e., Department for Education) or for bolstering the UK's resilience (i.e., Cabinet Office). Furthermore, the findings highlight that there may be inconsistencies between what schools are recommended to do by the UK Government and the resources that are publicly available to them. Schools are required to deliver an 'all-hazards' approach to preparedness but only four of the possible nine NRR risk themes were covered by the resources identified in the present review. Similarly, there were no publicly available resources related to the discussion or conduct of lockdown drills. As such, "ambiguity in legislative requirements" surrounding the delivery of school-based extreme event preparedness education may hamper efforts to deliver preparedness education in England [14]. In spite of this, many of the resources included in the review (N = 20) were published with consideration of the UK government requirements for the English national curriculum and signify where the resources can be used within this.

Similarities can be drawn between the methods employed in international examples and those recommended in the resources identified by this review. Hosting 'special events', completing activity booklets, playing board games, sharing feelings, and mapping local hazards are all learning modalities identified in international case studies of school-based extreme event preparedness [92]. Indeed, preparedness education delivered in schools is deemed "useful and beneficial" and can raise children's perception, knowledge, and awareness of extreme events [14]. However, it was not possible to ascertain whether the methods employed in the resources identified by this review are similarly 'useful' in bolstering preparedness knowledge across student populations in England due to an absence of evaluations of the delivery of these materials.

4.2. Recommendations for future research

Whilst the related preparedness literature proposes that schools can play a role in providing and strengthening preparedness knowledge, our review demonstrates that the role of schools in enhancing preparedness, and the effectiveness of extreme event preparedness education more generally, has yet to be established in England [23,26]. This review provides evidence that schools in England are in receipt of a range of educational extreme event preparedness materials. However, little is known about the appropriateness and effectiveness of these resources. As such, we recommend that the needs, attitudes, understanding and role of school populations (e.g., teachers, staff, pupils, and their adult carers) in extreme event preparedness education is explored. Further research with a focus on the attitudes and views of school senior leaders (i.e., principals, headteachers and senior leadership team's); on teachers' perceived capability in delivering extreme event preparedness materials in schools; and the combined view of whether materials designed to enhance resilience in school populations are appropriate for and able to address the needs of the local area. In line with this, future studies should explore students' attitudes towards receiving extreme event preparedness education in schools, including the focus and format of extreme event preparedness education. Understanding the views of these populations would provide evidence from the 'bottom-up'. At the very least, a formal evaluation of existing and future extreme event preparedness education delivered to schools in England would provide evidence of the benefits and potential unintended consequences of delivering disaster education to children and young people. Formal evaluation of extreme event preparedness education would also identify measurable improvements or decreases in preparedness as a result of these programmes and initiatives.

Finally, research exploring the views held in national and local government departments would be useful in identifying the attitudes towards and strategies for developing and integrating standardised disaster preparedness education in schools, from the 'top-down'. This would have the added benefit of addressing the core principles of the UK Government Resilience Framework [93] including developing a shared understanding of the civil contingencies risks; prevention, rather than cure where possible; and creating a shared understanding of "resilience as a 'whole of society' endeavour", and enhancing the effectiveness of the UK Government ambition to roll out first-aid training across schools. Furthermore, evaluation of existing and future preparedness education in English schools could have the added benefit of establishing a baseline of understanding and awareness impacting the NRR risk impacts and outcomes addressed by our study, and beyond. Taken together, the findings from the proposed suite of studies generating evidence around the effectiveness of extreme event preparedness education in schools will move us closer to realising the oft expressed ambition to enhance community resilience by enhancing the resilience of children in schools. Embedding the results into evaluations of the design, delivery and impact of extreme event preparedness education delivered in schools in England is especially important for addressing the perceived vulnerability of children and young people, as well as whether preparedness education 'prepares' these populations for the types of extreme events which will possibly affect them, as outlined in the NRR.

4.3. Methodological limitations

There were no resources identified through the academic database search, demonstrating a dearth of research on this topic. The study was therefore reliant on what could be found in Advanced Google searches. Considering this and the findings of the present study, it is reasonable to assume that individual organisations (here, charities, government associated organisations, and local author-

ities) will publish guidance or resources themselves. These organisations may run internal evaluations and gather feedback from schools about their resources. However, documents related to these assessments are not publicly accessible. As such it is not possible to assess or measure the effectiveness of preparedness education delivered in schools in England via this systematic review. In addition to this, the Advanced Google search strategy identified multiple websites which included possibly appropriate resources to be included but were locked behind a paywall or other membership fee, specific for teachers. These were not analysed since they could not be accessed.

5. Conclusion

Regulations and school-related policies for delivering and bolstering pre-event preparedness education to children and young people in UK and English schools are evolving. Schools continue to be identified as an appropriate space to provide extreme event preparedness education to children and young people, without evidence that delivery of these materials and programmes are effective in enhancing the resilience of school children or their surrounding communities. This review highlights the range of educational materials currently provided to schools in England to deliver preparedness education for extreme events. These materials are designed to increase student knowledge of extreme events both in the UK and internationally, whilst integrating risk awareness and outlining the potential impacts of incidents, including possible relief efforts. Some resources were designed to facilitate first-aid lessons in schools, as part of new mandatory guidance from the government. Teachers are required to deliver disaster preparedness materials either as stand-alone lessons or use preparedness resources to support existing lessons in the curriculum. However, there is little direct evaluation or feedback from school staff, or students, about their perceptions of and attitudes towards disaster education in schools. To truly bolster school preparedness for extreme events, more needs to be known about the effectiveness of preparedness materials, as well as the attitudes of school populations and policy makers towards preparedness education more generally. This information should be made publicly available and documented for researchers in the field of extreme event preparedness to harness findings and guide best practice for delivering preparedness education in schools in England.

Contribution statement

The authors confirm contribution to the paper as follows: study conception and design: A. Hodson, J. Pearce, R. Amlôt, M. B. Rogers; data collection: A. Hodson; analysis and interpretation of results: A. Hodson; draft manuscript preparation: A. Hodson, J. Pearce, R. Amlôt, M. B. Rogers. All authors reviewed the results and approved the final version of the manuscript.

CRediT authorship contribution statement

Ava Hodson: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft. **Julia M. Pearce:** Conceptualization, Methodology, Writing – review & editing. **Richard Amlôt:** Conceptualization, Methodology, Writing – review & editing. **M. Brooke Rogers:** Conceptualization, Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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Appendices

Appendix 1. Search strategy

A search of academic literature was conducted using Ovid MEDLINE, APA PsycINFO, Global Health, and Scopus. References and forward citations of included articles were searched. Databases were searched from inception to April 15, 2021. The following search terms were used: ((Student* OR School* OR Educat*) AND (Extreme event* OR Disaster* OR Hazard* OR Emergenc* OR Mass casualty OR Major fire* OR Terror* OR Malicious attack* OR Chemical, biological, radiological and nuclear attack* OR CBRN attack* OR Flood* OR Severe weather OR Pandemic OR First aid OR drill* OR fire drill*)) AND (Prepar* OR Resilienc*) AND (UK OR United Kingdom OR England OR English)). In addition to this, any stand-alone documents, guidance, or education that may have been referenced in the literature were searched for via Google, using the names or phrases used in the original document. This latter search yielded no new or relevant results.

A search of the grey literature was completed to identify any further stand-alone guidance documents and any research that is either unpublished or has been published in non-commercial form. Online searches were completed as a Google Advanced search, using the following filters: a) Language: English, b) Region: United Kingdom. The first 20 pages of results were searched. Twenty-five separate searches were done, using the following extreme-event related language: 'Disaster preparedness materials for schools', 'Extreme event preparedness materials for schools', 'Hazard preparedness materials for schools', 'Emergency preparedness materials for schools', 'Mass casualty preparedness materials for schools', 'Major fire preparedness materials for schools', 'Terrorism preparedness materials for schools', 'Malicious attack preparedness materials for schools', 'CBRN attack preparedness materials for schools', 'Flood preparedness materials for schools', 'Severe weather preparedness materials for schools', 'Pandemic preparedness materials for schools', 'Disaster resilience materials for schools', 'Extreme event resilience materials for schools', 'Hazard resilience materials for schools', 'Emergency resilience materials for schools', 'Mass casualty resilience materials for schools', 'Major fire resilience materials for schools', 'Terrorism resilience materials for schools', 'Malicious attack resilience materials for schools', 'CBRN attack resilience materials for schools', 'Flood resilience materials for schools', 'Severe weather resilience materials for schools', 'Pandemic resilience materials for schools', 'First aid materials for schools'. These were repeated for each of 'United Kingdom', and 'England'. Three additional searches were done using the following phrases: 'Training for disasters in schools', 'Educational programmes for disasters', 'Educational programmes in schools to prepare children for disasters.'

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